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Original article

Body composition and physical performance of school pupils in distinct institutions

Composição corporal e desempenho físico de escolares em instituições distintas

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ABSTRACT

Introduction: Technological advances, poor diet, and physical inactivity are some of the factors responsible for the increase in the number of children with chronic degenerative diseases, a current public health problem in different institutions of private and public education. **Aim:** analyze, classify, and compare the body composition and physical performance of students from private and public schools in coastal cities in São Paulo. **Methods:** 117 children, 58 volunteers from public schools, and 59 volunteers from private schools 8 to 11 years old were evaluated. The following evaluations were performed: anthropometry: body mass, height, body mass index (BMI), and body fat percentage (%BF) obtained through skinfold measurements (tricipital and subscapular). Physical performance: flexibility, handgrip strength, abdominal strength, and endurance. Statistical analysis: after confirming the non-normality of the data, we opted for the Mann-Whitney U test for comparison between the groups and the Student's t-test for comparison between the obtained value and the normative reference. **Results:** Children from the private school, when compared to those from the public school, revealed statistically significant differences for BMI, %BF, handgrip strength, and abdominal strength and endurance. **Conclusion:** These findings denote high values concerning the reference values for the anthropometric variables and values below the reference values for the physical performance variables, which can be harmful to the children's health in growth and development phase.

Keywords: child; physical activity; public health.

RESUMO

Introdução: O avanço tecnológico, a má alimentação e a inatividade física são alguns dos responsáveis pelo aumento no número de crianças que apresentam doenças de caráter crônico degenerativas, problema atual de saúde pública em diferentes instituições de ensino particular e público. **Objetivo:** Analisar, classificar e comparar a composição corporal e desempenho físico de escolares de instituições da rede privada e pública de uma cidade litorânea paulista. **Métodos:** Foram avaliadas 117 crianças, 58 voluntários de escolas públicas e 59 voluntários de escola particular com idade entre 8 e 11 anos. Foram realizadas as seguintes avaliações: antropometria: massa corporal, estatura, índice de massa corpórea (IMC), e percentual de gordura corporal (%GC) obtido por meio da utilização da medida das dobras cutâneas (tricipital e subescapular). Desempenho físico: flexibilidade, força de preensão manual, força e resistência abdominal. Análise estatística: após a confirmação da não normalidade dos dados, optou-se pelo teste de Mann- -Whitney U para comparação entre os grupos e o teste t Student para comparação entre o valor obtido e normativo de referência. **Resultados:** As crianças da escola privada quando comparadas às da escola pública revelaram diferenças estatísticas significativas para IMC, %GC, força de preensão manual e força e resistência abdominal. **Conclusão:** Esses achados denotam valores elevados em relação aos valores de referência para as variáveis antropométricas e valores abaixo dos valores de referência para as variáveis de desempenho físico, o que pode ser prejudicial à saúde de crianças em fase de crescimento e desenvolvimento.

Palavras-chave: criança; atividade física; saúde pública.

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Introduction

Health-related physical fitness is associated with a better quality of life [1,2], which is necessary to regulate and maintain motor, morphological and functional levels with desirable values, minimizing the risk of developing non-communicable chronic diseases (NCDs) [1,3]. NCDs are responsible for 70% of deaths worldwide, like obesity, heart disease, stroke, cancer, diabetes, and chronic lung disease. These range from premature babies to individuals over 70 years old. Low and middle-income countries are the most affected, with Brazil being one of them [4]. Four main factors cause NCDs: the consumption of tobacco, alcohol, poor diet, and physical inactivity [5].

Lack of movement is one of the central problems and, it may be related to technological advances and poor diet due to daily running life habits [6]. These factors have become a current public health problem, with an increase in the children number with chronic-degenerative diseases, among which obesity stands out [7,8]. The data presented by the study by Abarca-Gómez *et al.* [9] revealed that obesity increased more than ten times in individuals 5 to 19 years old, reaching 124 million people, corroborating the Brazilian Institute of Geography and Statistics (IBGE), when referring to overweight, the data are of 34.8% boys and 32% girls and obesity in 16.6% male and 11.8% female [10].

However, for this index to be identified, it is necessary to perform anthropometric assessments frequently, being an indication for detecting NCDs [11]. A study by Dos Santos & Da Silva [12] reveals that students of different levels of education, from elementary to high school, have lower physical fitness than expected in both public and private schools, and these results are confirmed in other studies [13].

These indications confirm the findings of Pelegrini *et al.* [14], who carried out an analysis of physical fitness in students from public and private institutions in five regions of Brazil, an evaluation about health criteria in a cross-sectional study, with the participation of 7507 students (4114 boys and 3393 girls), 7 to 10 years old. The above authors measured body mass, stature, flexibility, muscle strength/resistance, and cardiorespiratory fitness. For this study, they did not obtain positive results; concerning physical fitness, flexibility, muscle strength/resistance, and cardiorespiratory fitness; observing a high prevalence of pre-reached points established for a physical fitness adequate level.

Specifically, in a study carried out with children from five regions of Santos city, a low level of physical fitness was detected, compared to the expected health levels in public school students. It indicates that sometimes environmental conditions such as the city characteristics in question, like heat, humidity, and leisure space, such as the beach, do not seem to be enough to make children more active and healthier [15]. According to the literature, children currently seem to be less active and predisposed to developing NCDs. Therefore, from an academic point of view, it is plausible to investigate populations that reside in specific locations and that experience different school environments in such a way as to direct possible changes in public health policies.

Thus, this study aimed to analyze, classify and compare the body composition and physical performance of schoolchildren from private and public institutions in two cities on the coast of São Paulo state.

Methods

The study is an observational cross-sectional study, and a convenience sample was used. After the favorable opinion of the Ethics Committee (No. 1.621.19 and CAAE. 54163616.5.0000.5505), all volunteers and guardians signed the Informed Consent Form. 117 children participated in the study, being 58 students from a public school (30 female and 28 male) and 59 students from a private school (22 female and 37 male) aged between 8 and 11 years old, all residents of the city of Santos and Cubatão. The following topics were defined as exclusion criteria: refusal to participate in data collection, non-authorization by parents or guardians, any physical problem that prevented them temporarily or definitively from carrying out the evaluations, non-attendance at school on the day scheduled for the collection of data, and age that was not within the age range of 8 to 14 years.

For anthropometry, the measurements taken were: height, which was determined by the pocket-sized *Cescorf*® stadiometer with a 0.1 cm measurement scale; body mass, using the Tanita® Um-080 portable digital scale, with 100g precision, according to the standards idealized by Cameron [16].

With the measures of height and body mass, the body mass index (BMI) was calculated through the mathematical equation: BMI = Body mass (kg)/height² (m) [kg/m2]. To assess the skin folds thickness, a *Cescorf*® Premier Scientific Plicometer was used, with a 0.1 mm measurement precision. The percentage of body fat (%BF) was determined using predictive equations idealized by Slaughter *et al.* [17].

The motor performance levels were determined based on the analysis of the results observed through a battery of motor tests proposed by Guedes & Guedes [18], obeying the following sequence:

The Sit and reach test – performed with a sit-and-reach box aid, which presents a measurement with an amplitude of 0 to 50 cm. For this test's application, the subject was barefoot in a sitting position in front of the device with their legs under the box, their knees fully extended, and their feet leaning against it. The arms should be extended over the box surface with the hands placed one over the other and with the fingertips joined. To record the results, the subject, with the palms facing down and in contact with the box, performed trunk flexion to achieve the longest distance possible. The distance reached is recorded every 0.5 cm, determined by the maximum position reached by the fingertips and maintained for approximately two seconds. To ensure the result, the evaluator needed to hold the subject's knees. Three attempts were offered to the subject, and the longest distance achieved to measure flexibility (FLEX) was computed [19].

The handgrip test – the measurement of upper limb strength (ULS) was obtained using a Crown hydraulic manual dynamometer from the Oswaldo Filizola® industrial technique, respecting the protocol recommended by the American Association of Hand Therapists, in which those evaluated should remain standing with their arms extended at their sides, and with the dominant hand make three attempts for maximum strength with the determined device. The highest value reached by the subject was adopted after making three attempts. The measurement unit used in this test was the kilogram-force (kg/f) [20].

Modified sit-up test (SU) – the subject adopts the supine position on a mat (for more comfort), flexed hips and knees, and the soles of the feet facing the ground; arms crossed over the anterior face of the chest, with the palms of the hands facing the opposite shoulders. The feet must be held by the evaluator while standing with the feet on the ground. As for the test performance, the subject must raise the trunk to the level at which contact occurs on the anterior surface of the forearm with the thighs, immediately returning to the initial position until it touches at least the anterior half of the scapulae on the ground. These movements were repeated for 60 seconds, and the purpose of the test was to perform the greatest number of complete repetitions (rep) possible in the stipulated time [21].

For the tests carried out, the average value for each age group was assumed, presented in the reference tables of 1-5 [22] of each test, being:

Table I - Reference values for BMI (kg/m²)

Age	Male	Female
8	19.2	18.2
9	19.3	19.1
10	20.7	20.9
11	22.1	22.3

Table II - Reference values of the abdominal resistance test (rep)

Age	Male	Female
8	20	20
9	22	20
10	22	20
11	25	20

Table III - Flexibility test reference values (cm)

Age	Male	Female
8	32.5	39.5
9	29.2	35.0
10	29.5	36.5
11	29.5	34.5

Table IV- Reference values for the percentage of body fat (%BF)

Age	Male	Female
8	32.5	39.5
9	29.2	35.0
10	29.5	36.5
11	29.5	34.5

Table V - Reference values for upper-limb strength (kg/f)

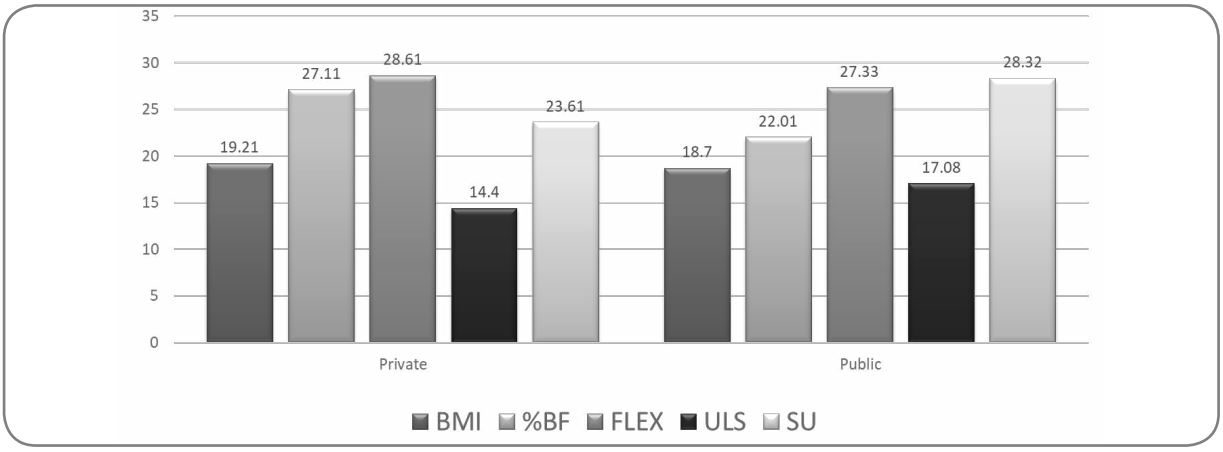
Age	Male	Female
8	13.5	10.9
9	15.5	12.3
10	17.8	14.4
11	20.4	17.0

Statistical analysis

After confirming the non-normality of the data by the Kolmogorov-Smirnov test, the Mann-Whitney U test was chosen for comparison between the groups. The student's t-test was used to compare the obtained value with the reference value. And the simple linear regression analysis was used to verify how much one variable explains the result of the others.

Results

Figure 1 shows the comparison between schools, showing a significant difference for the variables of BMI, %BF, ULS, and SU, with the private school presenting values related to variables of lower physical fitness when compared to the public one. The BMI and the %BF were higher for students from the private school, but for ULS and SU the results were higher in the public school compared to the private school. For the FLEX variable, there was no statistical difference between the institutions.



#indicates a significant difference between groups (private and public school); The level of significance adopted was $p \leq 0.05$.

Figure 1 - Comparative data on average values and standard deviation of the private and public schools for the variables body mass index (BMI), percentage of body fat (%BF), flexibility (FLEX), upper limb strength (ULS), and sit-up (SU).

Table VI presents the results referring to the comparative analysis between the mean values and standard deviation obtained in the private school and reference values (RV) related to health in the variables: BMI, %BF, FLEX, ULS, and SU.

Table VI - Variables evaluated in comparison to the reference value about age and gender in the private school

Age	Gender	BMI	RV	%F	RV	FLEX	VR	ULC	RV	SU	RV
8	F (4)	19.4±4.7	18.2	31.6±4.7	25%	30±8.1	21.4	11±1.7	10.9	16±5.8	20
8	M (7)	19.8±3	19.2	24.3±7.5	20%	22.5±6	29.3	13±1.9	13.5	14.5±11.4	20
9	F (11)	19.5±2.1	19.1	29.9±2.8*	25%	32±6.9*	21.4	14±3.3	12.3	17±11.8	20
9	M (16)	19.7±2.9	19.3	23.5±8.9	20%	28.5±9*	29.3	14±3	15.5	27±9.3	22
10	F (5)	18.1±2.1*	20.9	32.2±3.3	25%	26±2.9	23.5	14±2.9	14.4	24±10.9	20
10	M (11)	20.6±2.9	20.7	26.7±6.6*	20%	30±2.6*	29.4	17±4.3*	17.8	27±6.6*	22
11	F (2)	18.4±5.2	22.3	28.8±4.7*	25%	24±2.8	23.5	14.5±1	17	25±1.4	20
11	M (3)	21±3.1	22.1	29.5±5.5*	20%	32±3.2	27.8	17±6.4*	20.4	34±5.8	25

*indicates a significant difference between the results obtained and the reference values for health ($p \leq 0.05$); the values are in the form of mean and standard deviation (±); female (F); male (M); body mass index (BMI); reference value (RV); percentage of fat (%F); flexibility (FLEX); upper limb strength (ULS); sit-up (SU)

Figure 2 shows the number of children from the private school who presented values above, on average, and below the reference value [22] for health for all variables investigated.

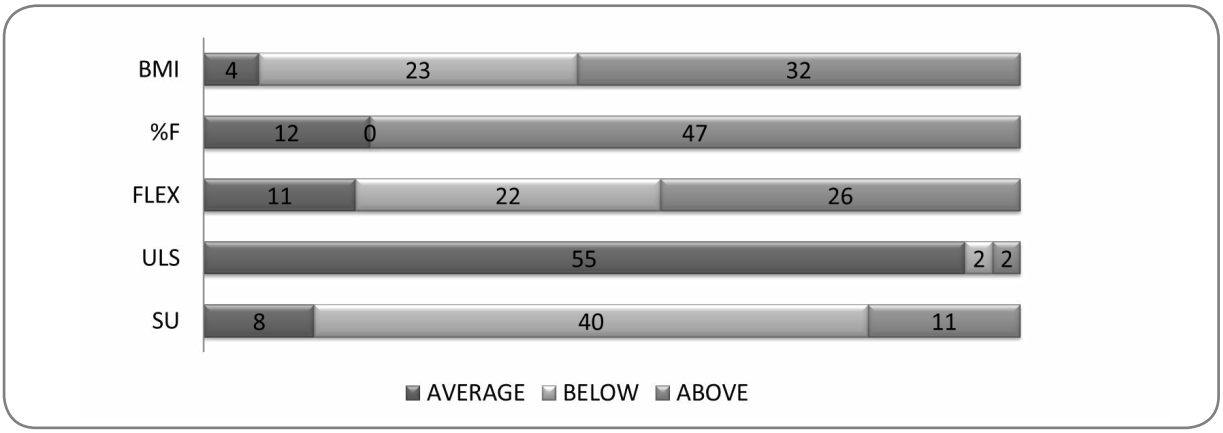


Figure 2 - Representation of the number of children from the private school who presented values above, on average, and below the reference value related to health for all variables

Table VI shows that in the private school, there was a statistical difference for the variables BMI and %BF when compared to the reference values, and the results were above expected, for the ages of 9, 10, and 11 years old, in both sexes for the %BF; and still, values lower than expected for FLEX in boys aged 9 years old, as well as for SU in girls aged 9 years old. Figure 2 shows the number of students from the private school in each classification, indicating that 79.6% of the children are above the reference value for %BF and 54.2% for BMI. In addition to 40% of children below expectations for SU tests and 22% below for FLEX tests.

Table VII presents the results referring to the comparative analysis between the mean values and standard deviation obtained in the public school and reference values (RV) related to health in the variables: BMI, %BF, FLEX, ULS, and SU.

Table VII - Variables evaluated in comparison to the reference value about age and gender in public schools

Age	Gender	BMI	RV	%F	RV	FLEX	RV	ULS	RV	SU	RV
8	F (4)	16.5±4.4	18.2	17.6±8.9	25%	29.5±3*	21.4	13±3.5	10.9	30±7.8	20
8	M (7)	17.3±1.3*	19.2	16.6±3.2*	20%	29.5±5	29.3	14.5±2	13.5	33±5.5*	20
9	F (7)	16.3±2.3	19.1	23.5±6.3	25%	31±2.9*	21.4	15±2.1*	12.3	26±12.7*	20
9	M (8)	19.9±4.2	19.3	18.5±12.4	20%	29±4.5*	29.3	15.5±2	15.5	28.5±12	22
10	F (6)	16.2±3.7*	20.9	15.1±7.5*	25%	29.7±2*	23.5	15.5±3	14.4	26±6.6*	20
10	M (5)	17.8±2.2*	20.7	24.9±8.9	20%	25±3.1*	29.4	16±2.9	17.8	25±6.4	22
11	F (13)	19±4.8	22.3	24.5±7.3*	25%	28±3.2*	23.5	22±4.9	17	30±8.4*	20
11	M (8)	18.1±3.9	22.1	20.5±10	20%	21.7±7	27.8	18±3.4	20.4	29±14.3	25

*indicates a significant difference between the results obtained and the reference values for health ($p \leq 0.05$); the values are in the form of mean and standard deviation (±); female (F); male (M); body mass index (BMI); reference value (RV); percentage of fat (%F); flexibility (FLEX); upper limb strength (ULS); sit-up (SU)

Figure 3 shows the number of children from the public school who presented values above, on average, and below the reference value [22] for health for all variables investigated.

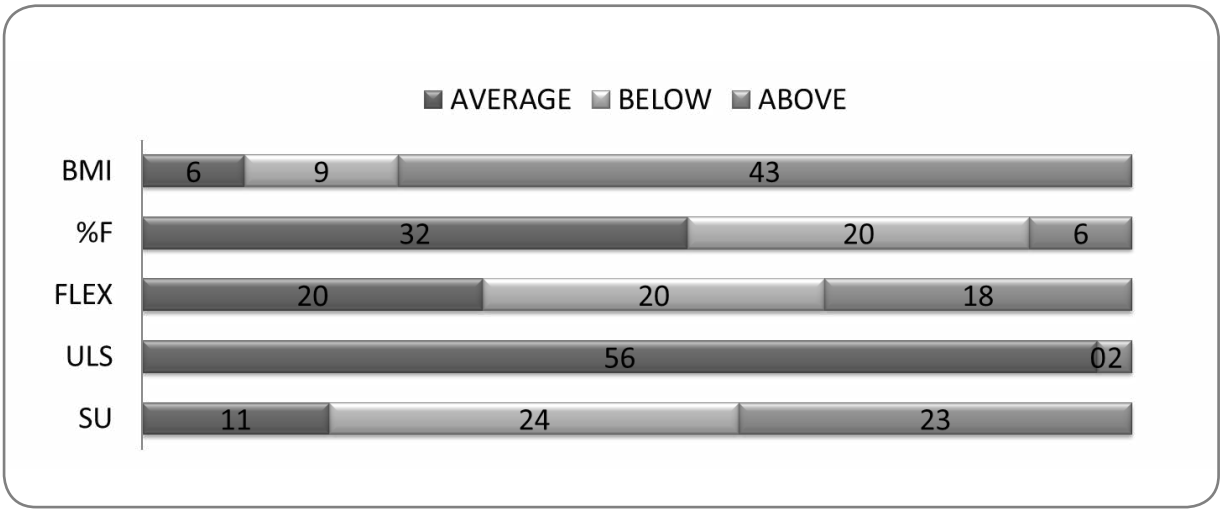


Figure 3 - Representation of the number of children from the public school who presented values above, on average, and below the reference value related to health for all variables

The Table VII indicate that the highest incidence of age variations was found in the FLEX variable analysis. However, when compared with the reference values, the students are within the parameters of the expected average values. The statistical differences presented about the SU test are high when compared to the reference values. Figure 3 shows the number of public-school students in each classification for the tests, indicating that 65.5% of the children were classified in the average or below the reference values for %BF and 84.4% for the BMI.

Table VIII - Linear regression between %F and SU, FLEX, ULS from private and public schools

	%BF		
	Beta	r^2	p
SU	-0.53	0.28	0.00
FLEX	-0.12	0.01	0.18
ULS	0.21	0.04	0.03

Beta = Probability distributions; r2 = determination coefficient; p = significance level

Table VIII represents the data for the %BF variable compared to the other physical fitness variables, in which an inverse correlation is observed for SU, with those who have a higher %BF performing fewer repetitions in the SU test and correlation for ULS.

Discussion

This study aimed to analyze, classify, and compare the body composition and physical performance of students from private and public institutions in coastal cities in São Paulo. The main findings were high values concerning the reference values for the anthropometric variables and values below the reference values for the physical performance variables, especially for children from the private school. Physical fitness is related to a better quality of life. However, some factors can harm people's health, and the main factor is a sedentary lifestyle [1,2].

According to Resende *et al.* [23], in a systematic review, 27 studies were selected who met all the requirements, and of these 13 studies dealt with a sedentary lifestyle in children and adolescents from zero to 18 years old. The authors showed evidence that a sedentary lifestyle due to technology and obesity have a strong correlation with NCDs, low physical fitness, and academic performance. The results of the present study showed low physical fitness for students, regardless of school. For comparison between public and private schools, significant differences were observed between them, disagreeing with studies found in the literature. These differences may be related to the methods adopted in different studies, such as Pinheiro *et al.* [24], who investigated only girls of an older age group than the one investigated in this study.

Hallal *et al.* [25] conducted a National Adolescent School-based Health Survey (PeNSE) with 60,973 young people, 9th-grade students from private and public schools in the capitals of Brazil through questionnaires. This study revealed that, across the country, a large part of the students is classified as inactive and insufficiently active and, in the southeastern region, 50.6% were classified as insufficiently active and 4.1% as inactive. This is in line with the findings of Abarca-Gómez [9], which showed an increase in obesity 10 times greater in 2016. In the present study, an increase in the %BF of students from a private school can be observed, demonstrating an indication of obesity.

In the experiment by Dal Mas *et al.* [26], a study was carried out with 94 students with an average age of 8 years, evaluating the children's nutritional status, corroborating the results found for high %F and BMI.

The study carried out by Andreasi *et al.* [27] analyzed 988 schoolchildren from different educational, private, philanthropic, and public-school systems, aged 5 to 17 years, and anthropometric measurements and physical performance tests were performed. The researchers found that females, principally, were more prone to abdominal strength/resistance inability, while obesity and abdominal hyperadiposity predispose students to abdominal strength/resistance and aerobic resistance inability. The excess of body adiposity increased the chances of weak trunk flexibility, which seems to agree with the current study.

The study by Santos *et al.* [28] found data like the results found for the %BF of the present study, and students from the private school also showed higher values than the public school. Miranda *et al.* [29] also compared private and public schools, evaluating 200 students (107 public schools and 93 private schools). The results agree with those found in the present study, with high BMI and %BF in private school students. The study by Mineiro *et al.* [15] mapped the regions of Santos city, verifying the behavior of the variables associated with the development and physical fitness related to children and adolescents' health. The author found results in agreement with the present study for the variables FLEX and SU. However, for the ULS, the results differed, since 96.5% of the evaluated were considered within the expected average values and according to the study by Schuastcer [30].

Petroski *et al.* [31] evaluated 4,495 adolescents aged 14 to 17 years old from the public system, in which anthropometric assessments and motor tests were carried out. The results pointed to a classification below the health criterion for body composition, motor tests, and flexibility, not coinciding with our findings. It can be speculated that the different results between these two studies could be related, among other factors, to the different age groups and the differences between the regions of the research (interior and coast of São Paulo).

However, Padilha *et al.* [32] carried out a study in Rio de Janeiro to investigate the body adiposity indexes (height, body mass, skin folds, and %BF), nutritional status, and food consumption of schoolchildren of different socioeconomic levels. The sample was composed of 106 students: 57 from private schools and 49 from public schools with an average age of 12. The results showed higher adiposity in private school female students when compared to girls from the public school, corroborating the findings in the present study. On the other hand, there was no difference between the boys from both schools about the %BF. However, these data do not confirm our findings of boys from the private school that presented a high %BF while compared to those evaluated in the public-school system.

And finally, the study by Sartorio *et al.* [33] performed a correlation with the ULS and anthropometric variables, composed of 332 individuals 5 to 15 years old, subdivided into 3 groups classified by the state of maturity of Tanner's board, being

group 1 stage 1, group 2 stage 2-3, group 3 stage 4-5. In the 3 groups, there was a correlation between ULS and %F, supporting this study's finding.

Conclusion

Schools showed statistical differences for the variables BMI, %BF, ULS, and SU. However, the private school showed more worrying results concerning health while compared to the public school. In this regard, children in the private school are above the reference value for %BF and BMI; and below for performance in the SU test, while children in the public school are within the values for the same variables representing positive values for health. School-based lifestyle change programs oriented to physical fitness and dietary fitness, would perhaps fulfill the goals of promoting eutrophy and greater physical fitness for schoolchildren.

Potential conflict of interest
No potential conflict of interest relevant to this article was reported.

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Authors' contributions
Conception and design of the research: Mineiro AS, Siriaco CM. **Data collection:** Alves IS. **Analysis and interpretation of data:** Madureira F, Santos RMS, Guedes Jr D. **Statistical analysis:** Colantonio E. **Writing of the paper:** Siriaco CM, Mineiro AS, Silva RP. **Critical review of the paper for important intellectual content:** Mineiro AS, Colantonio E, Silva RP.

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